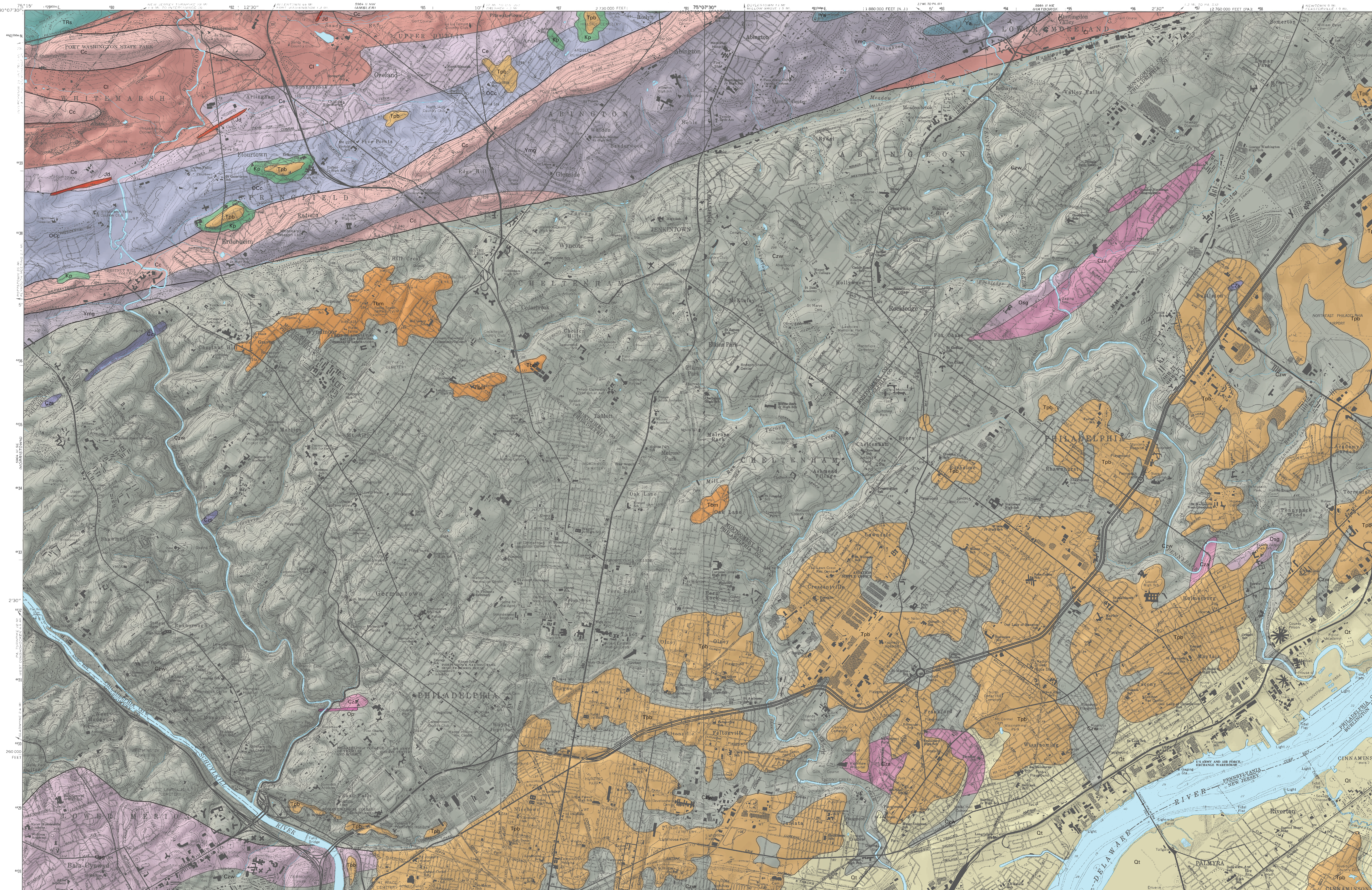
U. S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

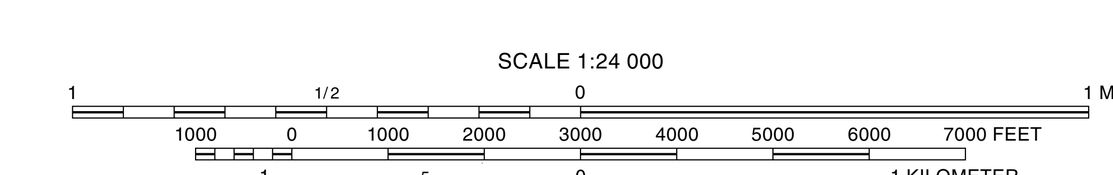
Prepared in Cooperation with the
U. S. ARMY CORPS OF ENGINEERS

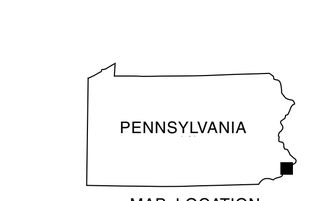
OPEN-FILE REPORT 00-224
PLATE 1

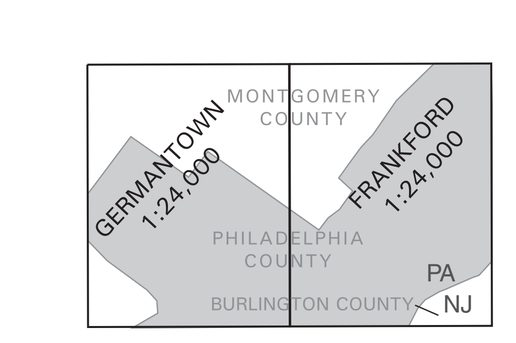


Base from U.S. Geological Survey Digtial Raster Graphics (DRG's) of Frankford, 1997 and Germantown,1997.

North American Datum of 1927 (NAD 27)
Projection: Universal Transverse Mercator (UTM), zone 18







Study area quadrangle index map

Geologic map compiled by J. B. Epstein. Adapted from Bascom and others (1909), U.S. Geological Survey (1967a), Berg and others (1980), Berg and Dodge (1981), and Lyttle and Epstein (1987).

Digital Cartography by S. Hinman and P.Chirico.

CORRELATION OF MAP UNITS

Coastal Plain
- Qt — Quaternary
- Tpb, Tbm — Tertiary
- Kp — Cretaceous

Piedmont
- Jd — Jurassic
- Trs — Triassic
- Op, Osg, OCc — Ordovician
- Ce, Cl, Cc — Cambrian
- CZa, CZs, CZw — Proterozoic Z
- Ya, Ymg — Proterozoic Y

DESCRIPTION OF MAP UNITS

Qt **Trenton gravel of Lewis (1880) (Pleistocene) -** Interbedded, cross-bedded sand and gravel with oblate pebbles and cobbles, and local clay and silty clay. Rare large boulders several feet long in places. Ranges in thickness from a feather edge at the northwestern contact to more than 100 feet. Forms a terrace which rises to about 60 feet above the Delaware River at the Tacony Bridge, where the unit is about 120 feet thick (Owens and Minard, 1979). The pebbles are derived from Triassic red and gray shales, sandstones, and conglomerate, and other bedrock up-valley. Human artifacts (Lewis, 1880) suggest an age no greater than about 11,000 years for part of the unit, although Owens and Minard (1979, p. D38, D42) suggest a Sangamon age of approximately 100,000 years for their "Spring Lake beds" and younger "Van Sciver beds" of the "Trenton gravel". The unit is therefore probably a combination of Wisconsinan glacial outwash and older interglacial estuarine sediments. These sediments were incorrectly identified as the Potomac Group by the U.S. Geological Survey (1967b); Owens (1999) mapped the Potomac Group at much higher altitudes and approximately 10 miles north of the river.

Tpb **Pensauken and Bridgeton Formations,** Undifferentiated (Tertiary, Miocene) - Interbedded yellow, white, to reddish, commonly iron-stained, planar- to cross-bedded, variably sorted sand and gravel with minor clay and silt. Gravel may be cobbly and contain rare boulders as much as 6 feet long. Pebbles are mostly quartz, chert, and quartzite pebbles; granite and gneiss are less common, and shale, arkosic sandstone and diabase even less. The sand comprises predominantly quartz, with weathered feldspar, glauconite, and iron oxide as minor constituents. May be moderately cemented with iron oxide. Thickness reaches 50 feet in Philadelphia, but it is generally much less than that. The Pensauken and Bridgeton Formations, undifferentiated, form dissected flat terraces that rise from about 60 feet altitude, where it is in contact with the Trenton gravel, to about 120 feet in the main outcrop area of the formation. Small exposures in the northern portion of the map exceed 300 feet.

Tbm **Bryn Mawr Formation (Tertiary, Oligocene?) -** White, yellow, and brown gravel and sand with local silt and clay, commonly cemented with iron oxide. Clasts are composed of quartz and quartzite and are not more than 5 inches long. The Bryn Mawr occurs in isolated upland terrace remnants between 200 and 400 feet altitude. It is no more than about 30 feet thick.

Kp **Potomac Formation[1] (Upper Cretaceous) -** Variegated, thick-bedded clay, sandy clay, sand, and gravelly sand. Local gravel beds, especially near the base. Sand beds are cross bedded and planar bedded and comprise mostly quartz, with lesser feldspar and mica. Gravel consists mainly of quartz and quartzite. The clay beds are lenticular and kaolinitic, and siderite pellets are locally abundant. Thickness ranges from 0 to 150 feet thick, but appears to be no more than 20 feet thick in the map area. The Potomac Formation is exposed in small areas in the northern part of the map at altitudes of about 300 feet.

[1] The Potomac Formation was suggested for use in Pennsylvania by Owens (1999) as a substitute for the Patapsco and Raritan Formations in Pennsylvania.

Jd **Diabase -** Dark-gray to black, fine- to coarse-grained diabase dikes composed largely of plagioclase and augite. Surrounding rocks may be thermally altered.

Trs **Stockton Formation (Upper Triassic) -** Light- to medium-gray and light-yellowish-gray, thin- to thick-bedded, fine- to coarse-grained, feldspathic sandstone, arkose and arkosic conglomerate with pebbles of quartz, quartzite and metamorphic rocks; grayish-red to moderate-reddish-brown, and light- to medium-gray siltstone and shale; and grayish-red to reddish-brown , thin- to thick-bedded, very fine to medium-grained, arkosic sandstone, generally fining upward with abrupt lateral lithic changes.

Op **Pegmatite -** Coarse-grained quartz, feldspar, and mica in veins

Osg **Swarthmore Granodiorite (Ordovician)**--Medium- to coarse-grained, generally massive, microcline-oligoclase-quartz-biotite-muscovite gneiss with accessory epidote, sphene, and apatite, and associated migmatite, granulite, and amphibolite. The contact between the Wissahickon Formation (CZw) and the Swarthmore is characterized by a series of replacement textures. However, a thrust fault brings the Wissahickon south over the granodiorite, further complicating the relations between these units

OCc **Conestoga Limestone (Lower Ordovician to Middle Cambrian)--**Very light- to medium-gray, fine- to coarse-grained, thin-bedded, medium- bedded at base, impure (highly micaceous) limestone and minor shale; phyllitic in places with argillaceous partings parallel to regional cleavage; local dark-gray, fine-grained, thin-bedded dolomite in lower part. Lower contact probably unconformable. Maximum thickness of about 750 feet.

Ce **Elbrook Formation (Upper and Middle Cambrian)--**Light-gray, laminated to thin-bedded, siliceous, fine-grained, phyllitic limestone and lesser dolomite which weathers to a shaly, light-yellowish- brown carbonate rock. Interbedded with cream-colored to pure-white, fine-grained, thin-bedded, laminated dolomitic marble. Concentrations of mica are left as a pressure-solution residue parallel to regional cleavage. The lower contact is gradational. The thickness is approximately 800 feet.

Cl **Ledger Dolomite (Middle Cambrian)--**Light- to medium-gray, thin-bedded to massive, coarse-grained, high- magnesium dolomite with some siliceous beds which weather to rust-stained, granular, cherty layers and interbedded laminated limestone that weathers to a rough granular surface. The lower part of the unit is characterized by alternating light and dark layers and porous, cherty layers. Weathers to a characteristic light-yellow, earthy soil. Lower contact is gradational. Thickness is approximately 1,000 feet.

Cc **Chickies Quartzite (Lower Cambrian)--**Upper part consists of gray, medium-grained, laminated to medium-bedded and massive, cross bedded, vitreous quartzite and fine-grained, thin-bedded, feldspathic quartzose schist, conglomeratic at base. Lower part consists of gray, coarse-grained, tourmaline-bearing quartzite, arkosic-pebble conglomerate, and black slate and biotite schist, Lower contact unconformable. Thickness about 1,000 feet

Cza **Amphibolite (Cambrian and Late Proterozoic)--**Fine- to coarse-grained, "salt and pepper"-textured, hornblende-plagioclase-epidote- bearing amphibolite, epidote amphibolite, and well-foliated metagabbro, with minor magnetite in discontinuous layers, lenses and pods.

Czs **Serpentinite (Cambrian and Late Proterozoic)--**Serpentinite and related ultramafic rocks in highly sheared tectonic lenses, pods, and slivers with abundant actinolite and chlorite. Forms a thin poor soil.

Czw **WISSAHICKON FORMATION (Cambrian and Late Proterozoic)--**Medium- to dark-gray to black, brownish-gray to slightly rusty weathering, medium- to coarse-grained, aluminous, quartz-feldspar-biotite-muscovite schist, garnetiferous in places, feldspathic metagraywacke with thin interbedded amphibolites, and lenses and pods of altered ultramafic rocks. Thickness is difficult to determine because of folding, but possibly as much as 2000 feet thick. Contact with the Swarthmore Granodiorite (Osg) is probably a back-thrust fault bringing the Wissahickon south over the granodiorite. The upper surface of the Wissahickon in commonly chemically weathered to saprolite, consisting of soft decomposed clayey, silty, and sandy material that preserves the original structure of the parent rock. It may reach more than 50 feet in thickness (Fergusson, 1988).

Ya **Amphibolite (Middle Proterozoic)--**Medium- to coarse-grained, very dark gray to black, hornblende-plagioclase schist and gneiss with accessory hypersthene, magnetite, epidote, zircon, pyrite and sphene. Probable protoliths are sedimentary, generally associated with calcareous schists and gneisses, and igneous, associated with both metaplutonic and metavolcanic rocks

Ymg **Amphibolitic migmatite and related hybrid rocks--**Interlayered quartz-orthoclase-biotite-hornblende gneiss, with accessory epidote, titanite, staurolite, and augite, garnetiferous in places, and amphibolite. In places grades into a gray gneiss of intermediate composition.

EXPLANTION OF MAP SYMBOLS

- Fault
- Contact

GEOLOGIC MAP OF THE FRANKFORD AND GERMANTOWN QUADRANGLES, PHILADELPHIA AND MONTGOMERY COUNTIES, PENNSYLVANIA AND BURLINGTON COUNTY, NEW JERSEY

By
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2000